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The Potential for Methane Isotopologue Channels in GOSAT-2

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Of the major Greenhouse Gases (GHGs) currently considered as having a major impact on atmospheric chemistry, Methane is amongst the most important (IPCC, 2014). Methane concentration in the atmosphere has been documented to be rising steadily over the past century, aside from an unexplained short period in the middle of the last decade (Heimann., 2011), leading to renewed efforts to understand global atmospheric Methane.

Atmospheric Methane is primarily composed of two key isotopologues, 12CH4 and 13CH4, which have a natural abundance of about 98% and 1.1% respectively. It is a well-established fact that different sources of Methane (i.e. biogenic sources such as methanogens, or non-biogenic such as industrial hydrocarbon burning) vary in the abundance of these isotopologues (Etiope, 2009). The global identification of the ratios of these isotopologues could vastly increase knowledge of global Methane sources, and shed some light on global Methane growth.

GOSAT-2 due to be launched in 2018 is a follow on from the original GOSAT mission launched in 2009. GOSAT-2 aims to continue the legacy of GOSAT by providing global measurements of Methane and Carbon Dioxide on a global basis in order to monitor GHG emissions. GOSAT-2 in the context of this study has a significant advantage over GOSAT, which is the extension of the sensitivity of band 3 to 2330nm from 2080nm where significant numbers of Methane spectral lines are located.

In this study we apply the well-established Information Content (IC) analysis techniques originally proposed by Rodgers (2000) to determine the potential benefit of retrieving total column Methane isotopologue concentrations assuming bands 2 and 3 of the GOSAT-2/TANSO-FTS-2 instrument. The value of such studies has been proven on multiple occasions and can provide guidance on appropriate potential retrieval setups. Due to the fact that there has been limited research in this area, no ‘a priori’ state vectors or Variance Covariance Matrices (VCMs) appropriate for isotopologues have been defined previously, we therefore test a number VCMs in order to explore the constraints on retrieving independent information in the total column based on the IC analysis. This analysis and VCM variations also provide the opportunity to explore the potential errors associated with retrievals of isotopologues.

Based on this study we will comment on the feasibility of Methane isotopologues retrieval with GOSAT-2 under a range of atmospheric conditions, instrument geometry and VCM setups, as well as the errors associated with these conditions.

References:

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